

- 1 Title of the Invention**
- 2 An internal combustion engine machine incorporating significant improvements in**
- 3 power, efficiency and emissions control**
- 4**
- 5 Cross Reference to Related Applications**
- 6 This application is based on provisional application serial number 60/424,981, filed on**
- 7 November 08, 2002.**
- 8**
- 9 Statement Regarding Federally Sponsored Research or Development**
- 10 Not Applicable**
- 11**
- 12 Description of Attached Appendix**
- 13 Not Applicable**
- 14**
- 15 Background of the Invention**
- 16 This invention relates generally to the field of internal combustion engines and**
- 17 more specifically to an internal combustion engine machine incorporating significant**
- 18 improvements in power, efficiency and emissions control.**
- 19 This invention was conceived in response to the need for greater simplicity,**
- 20 efficiency and power in internal combustion piston engine designs.**
- 21 Although two-stroke cycle engine technology has many advantages, it has**
- 22 deficiencies have caused widespread legislative restriction on its use and, in the US, an**
- 23 outright EPA ban on it by the year 2006.**

1 Additionally, in nations where sophistication of publicly available technology is
2 low, the prevalent two-cycle technology is producing high levels of air pollution and
3 creating excessive fuel and lubricating oil expense due to the fact that the lubricating oil
4 is burned along with the fuel in inefficient combustion. However, it is the only
5 technology that the users can afford to acquire and maintain. This invention was
6 conceived to defeat these problems.

7 Prior internal combustion piston engine technology has been divided into two
8 primary groups, two-stroke cycle engines and four-stroke cycle engines. Prior two-
9 stroke cycle engine technology has a number of advantages over four-stroke cycle
10 technology. These advantages are a higher power to weight ratio and greater design
11 simplicity that results in low production and maintenance costs. Four-stroke technology,
12 on the other hand retained advantages over two-stroke technology in efficiency,
13 dependability, and clean operation. No prior technology produced the advantages of
14 both types in one engine.

15

16 Two Stroke Engine Technology Prior Art in General

17 Prior two-stroke cycle engines suffer a number of deficiencies. They are
18 inefficient, up to or beyond ten times less efficient than comparable four-stroke cycle
19 engines. They also inconveniently require that oil be measured and mixed with their
20 fuel. As a result, prior two-stroke cycle engines operate much less cleanly than
21 comparable four-stroke cycle engines, produce several times the volume of toxic
22 emissions over that of comparable four-stroke cycle engines, experience a high
23 incidence of plug fouling, are notoriously undependable, and use excessive fuel and
24 lubricant.

1 Previous attempts at improved two-stroke technology have included liner engine
2 configurations with pistons in each piston pair located diametrically opposite one
3 another, as does this invention. One such popular configuration is popularly known as
4 the "Bourke" engine. However, such previous liner designs have had a comparably
5 narrow range of RPM speeds within which they could perform. These speeds are
6 unsatisfactory for many applications and also complicate engine performance and
7 design parameters for the various internal components.

8 Prevalent conventional engine technology causes wear on the many moving
9 machine parts, largely due to components of articulated motion. This wear is
10 concentrated, in particular, on the pistons, piston rings, cylinders, wrist pins, connecting
11 rod bearings; main bearings and other related principal parts.

12 In present conventional engine technology, high operating temperatures bring
13 increased complexity and expense in engine design and choice of materials.

14 Present conventional technology is not adaptable to attain significant energy
15 savings by being run on fewer than all cylinders, when full power is not required, letting
16 the unused cylinders and pistons disconnect from the drive train and come to complete
17 rest until again needed.

18

19 Cylinder Head Exhaust Valve Prior Art

20 A number of cam or hydraulically controlled cylinder head exhaust valves are
21 taught in prior two-stroke technology, but none were found teaching cylinder head
22 exhaust valves applied to spark ignited two-stroke technology. However, spark ignition
23 is the more compatible, and therefore overwhelmingly more dominant, configuration for
24 lightweight engines. Therefore, this new use of a cylinder head exhaust valve in

1 application to spark ignited two-stroke technology with the resultant increase in
2 efficiency and reduction in toxic emissions is a much-needed improvement.

3 US patent 2,097,883 to Johansson teaches an exhaust valve for two-stroke cycle
4 diesel engines (i.e., not spark ignited). The valve in that patent is specifically designed
5 to control combustion chamber pressure in compression ignition engines.

6

7 Oil Hoarding Rings Prior Art

8 No use of rings on a piston for the purpose of sealing the lubricated space and
9 retaining oil between them has been found in prior technology. In fact, US patent
10 4,364,307 teaches against such usage, particularly noting that it would be inappropriate
11 to place sealing rings both above and below a lubrication groove. That, however, is
12 precisely one design characteristic of this invention.

13 Dynamic Pressure Pump, Double-Acting Piston Rod and Multi-Function Pistons to
14 Carry, Distribute, and Recover Lubrication Oil

15 A number of patents teach the transport of lubrication oil via a piston rod and/or
16 pistons adapted to distribute oil transported by such a rod. Some use dynamic energy
17 to propel the oil. (The general principle of dynamic energy/pressure pumps is to apply
18 dynamic energy to the medium, such as oil, by scooping it up and propelling it by rapid
19 cyclical motion.)

20 However, none of said patents provide for complete "round trip" oil circulation via
21 this method. They transport oil only one-way. This necessarily limits utility of the oil in
22 cooling the engine, for it must either be slowly metered out so as to prevent a significant
23 amount of it burning with the normal engine combustion, or it must be restricted from the
24 cylinder interior entirely.

1 Further, dynamical propulsion oil pumps and oil carrying piston rod systems
2 consistently teach their use only in lubricating the piston wrist pins, or lubricating/cooling
3 the bottoms of the pistons. None are designed, as this patent teaches, to provide the
4 primary lubrication to cylinder walls plus a return route for the oil for complete circulation
5 loops. Examples include US patents 2,569,103 and 2,645,213 (to Huber), US patents
6 4,466,387, 4,502,421, and 4,515,110 (Perry), US patent 2,865,349 (MacDonald), US
7 patent 3,633,468 (Burck), US patent 3,992,980 (Ryan et al), and US patent 3,930,472
8 (Athenstaedt), and US patent 2,899,016 (Swayze).

9 Additional examples of systems incorporating piston rod oil transport also include
10 pressure sealed walls at the base of their cylinders, as does this patent application.
11 (These sealed walls are also known as "cross heads.") However, as in those described
12 above, none provide for complete oil circulation cycles to include oil return from the
13 engine cylinder to the sump. Examples of these include US patents 1,268,056
14 (Ruether), 1,827,661 (Kowarick), 2,064,913 (Hedges), 2,244,706 (Irving) and 3,710,767
15 (Smith).

16

17 **Brief Summary of the Invention**

18 An object of the invention is to provide an improved two-cycle reciprocating
19 internal combustion engine that eliminates the previous disadvantages of two cycle
20 technology as compared to four cycle technology, in that this engine produces higher
21 efficiency, decreased toxic emissions, less fouling, and greater dependability while
22 retaining the advantages of simplicity of production and of maintenance, and high power
23 per unit weight.

1 Still yet another object of the invention is to provide an improved reciprocating
2 internal combustion engine wherein, it is possible to increase the power or torque to
3 weight ratio up to 100 percent or more over that of four-cycle technology without
4 increasing the bore and stroke, compression ratio, or number of cylinders, while at the
5 same time retaining a wide available range of RPMs, particularly including the most
6 desirable or recommended operating engine speeds with special consideration given to
7 friction heat and reciprocal motion, and thereby maintaining the most desirable
8 aspiration conditions and reciprocating valve performance characteristics, resulting in a
9 more efficient fuel consumption rate, over previous conventional or liner two-cycle
10 engines.

11 Another object of the invention is to provide two-cycle engine that, unlike two
12 cycle engines under previous technology, is not subject to the inconvenient necessity of
13 mixing lubricating oil with the fuel in the same tank, nor in the combustion chamber.

14 A further object of the invention is to provide a two-stroke cycle internal
15 combustion engine in which the lubricant circulates and is re-used independently from
16 the fuel, thus using less lubricant.

17 Another object of the invention is to provide a two-cycle engine that, unlike
18 two cycle engines under previous technology, is not subject to the extremely high
19 pollutant emissions that result from the necessity of mixing lubricating oil with the fuel in
20 the combustion chamber.

21 Still yet another object of the invention is to provide a two cycle engine that,
22 unlike two cycle engines under previous technology, is not subject to the
23 undependability and frequent spark plug fouling that results from the necessity of mixing
24 lubricating oil with the fuel in the combustion chamber.

1 Another object of the invention is to provide a simple, compact engine structure
2 that is, aside from the drive train, essentially symmetrical wherein oppositely disposed
3 parts are substantially identical.

4 Yet another object of the invention is to provide an internal combustion engine
5 that is simple and inexpensive to build and maintain.

6 Another object of the invention is to provide an improved reciprocating internal
7 combustion engine wherein the wear caused by friction on piston, piston rings,
8 cylinders, wrist pins, connecting rod bearings; main bearings another principal parts of
9 the engine is significantly reduced below that of in conventional two-cycle or four-cycle
10 engines having the same bore, stroke, compression ratio and number of cylinders
11 through virtually eliminating piston side loads and the resultant piston and cylinder wear.

12 Yet another object of the invention is to produce an improved reciprocating
13 internal combustion engine wherein each cylinder can produce one combustion stroke
14 with each revolution of the crankshaft. This amounts to two power strokes for each
15 piston pair for each shaft revolution and a power stroke for each movement of the piston
16 rod.

17 Another object of the invention is to produce an improved reciprocating internal
18 combustion engine wherein the piston rod travel between combustion strokes is 50
19 percent less than in present conventional two-cycle technology engines of the same
20 bore and stroke, compression ratio, and number of cylinders, thus saving energy
21 wasted in previous technology and saving commensurate fuel.

22 A further object of the invention is to provide an improved internal combustion
23 reciprocating engine that runs significantly cooler than those of present technology, thus
24 reducing corrosion and wear and making choice of applicable construction materials

1 broader and less expensive. The improved cooling is derived from the increased
2 lubricating/cooling oil flow provided and also from expansion cooling of the exhaust
3 gases.

4 Another object of the invention is to provide an improved reciprocating internal
5 combustion engine having increased life expectancy by reducing the need for the
6 engine to labor excessively or to be operated in an R.P.M. speed range that is beyond
7 the design capability originally intended or recommended in order to fulfill the
8 requirements for torque and/or horsepower.

9 Another object of the invention is to provide a linear two-stroke cycle internal
10 combustion engine that operates smoothly and efficiently over a wide range of rpm
11 speeds.

12 Still yet another object of the invention is to provide an improved reciprocating
13 internal combustion engine that is particularly adaptable to being run on fewer than all
14 cylinders when full power is not required, letting unused banks of cylinders and pistons
15 disconnect from the drive train and come to complete rest until again needed, thus
16 saving energy and also ensuring that the load on each end of the piston rod remains
17 substantially equal in that for any given fuel setting the force of the explosion is the
18 same, that is, the unit force exerted upon the opposite ends of the piston rod by
19 successive explosions is equal, even when a pair of pistons is put in "resting" mode.

20 A further object of the invention is to provide an internal combustion engine that
21 can operate using a wide range of fuels to include alcohol, gasoline, diesel, and others.

22 Still yet another object of the invention is to provide an internal combustion
23 engine that is easily adapted for glow plug, spark ignition or compression ignition.

1 Another object of the invention is to provide improved reciprocating internal
2 combustion engine technology compatible to both two-cycle and four-cycle technology
3 of increased simplicity over each or these present technologies.

4 Other objects and advantages of the present invention will become apparent
5 from the following descriptions, taken in connection with the accompanying drawings,
6 wherein, by way of illustration and example, three embodiments of the present invention
7 are disclosed.

8 In accordance with preferred embodiments of the invention, there is disclosed a
9 reciprocating internal combustion engine machine incorporating significant
10 improvements in power, efficiency and emissions control, primarily by eliminating the
11 mix lubricating oil with the engine fuel and segregating the lubricating oil and fuel at all
12 times.

13

14 **Brief Description of the Drawings**

15 The drawings constitute a part of this specification and include exemplary modes
16 of the invention, which may be embodied in various forms. It is to be understood that in
17 some instances various aspects of the invention may be shown exaggerated or
18 enlarged to facilitate an understanding of the invention.

19

20 Fig. 1 is a perspective view of the engine in the first preferred mode from the
21 back or "cam drive" side.

22 Fig. 2 is a perspective view of the engine in the first preferred mode from the
23 front or "output shaft" side.

1 Fig. 3 is a cutaway view of the engine in the first preferred mode from the front or
2 "output shaft" side.

3 Fig. 3A is a cutaway view of the engine in the second preferred mode from the
4 front or "output shaft" side.

5 Fig. 3B is an expanded cutaway view of a section of the engine as illustrated in
6 Fig. 3A.

7 Fig. 3C is a perspective three quarter view with phantom images of the cylinder
8 interior of the engine in the second preferred mode.

9 Fig. 3D is a perspective three quarter view of the engine in the second preferred
10 mode.

11 Fig. 4 is a view of the engine oil sump/crankcase, configured for the first or
12 second preferred modes, from the top with the top-plate removed, providing a view of
13 the gears.

14 Fig. 5 is a cutaway view of the engine sump/crankcase, configured for the first or
15 second preferred modes, from the back or "cam drive" side.

16 Fig. 6 is a partial cutaway side view of the multi-function piston configured for the
17 first or second preferred modes.

18 Fig. 7 is a top cutaway view of the multi-function piston configured for the first or
19 second preferred modes.

20 Fig. 8 is a bottom cutaway view of the multi-function piston configured for the first
21 or second preferred modes.

22 **Fig. 9 is a cut-away view of a portion of the engine incorporating a "pop-**
23 **top" multi-function piston as used in the third preferred mode.**

1 Fig. 10 is a side view of a "pop-top" multi-function piston having an air/fuel
2 intake valve in its head, as used in the third preferred mode, with the valve in the
3 open position.

4 Fig. 11 is a side view of a "pop-top" multi-function piston of the third
5 preferred mode as in Fig. 10, but with the air or air/fuel intake valve in the closed
6 position.

7 Fig. 12 is a top view of the "pop-top" multi-function piston used in the third
8 preferred mode as represented in Figs. 10 and 11.

9 Fig. 12a is an expanded top view of the center section of the multi-function
10 "pop-top" piston illustrated in Fig. 12.

11 Fig. 13 is a perspective view of the engine in a single cylinder configuration,
12 aspirated and lubricated after the manner of the first preferred mode.

13
14 Lists of Numbered Components for Each Figure

15 FIG. 1

16 100	engine
17 101	oil sump/crank case
18 101a	oil sump/crank case top and top plate
19 101b	oil sump/crank case combination end walls/cylinder compression walls
20 101c	oil sump/crank case side walls
21 101d	oil sump/crank case bottom
22 102	air/fuel intake manifold
23 102a	carburetor

- 1 102b fuel inlet
- 2 102c throttle cable
- 3 102d carburetor air intake
- 4 102e one-way air intake reed valve housing
- 5 103 cylinder
- 6 103a cylinder sidewall
- 7 104 cylinder head
- 8 105 exhaust assembly block
- 9 106 exhaust cam block
- 10 107 exhaust port to atmosphere
- 11 108 exhaust cam passive sprocket
- 12 109 exhaust cam power sprocket
- 13 110 exhaust cam drive belt
- 14 111 exhaust cam belt tension pulley
- 15 112 output drive shaft
- 16 113 spark-plug
- 17 114 spark-plug wires
- 18 115 air/fuel transfer passage cover

- 19
- 20 FIG. 2
- 21 105 exhaust assembly block
- 22 106 exhaust cam block

- 1 114 spark-plug wires
- 2 201 combination fly-wheel/starter cog
- 3 202 starter motor (engaged)
- 4 206 exhaust valve cam
- 5 207 magneto pick-ups

6

7 FIG. 3

- 8 101 oil sump/crank case
- 9 101b oil sump/crank case combination end walls/cylinder compression walls
- 10 103 piston cylinder
- 11 103a cylinder side wall
- 12 104 cylinder head
- 13 107 exhaust port to atmosphere
- 14 112 output drive shaft
- 15 113 spark-plugs
- 16 115 air/fuel transfer passage cover
- 17 301 oil
- 18 302 sump oil pick-up pipe
- 19 302a sump oil pick-up pipe nozzle
- 20 303 sump oil return outlet pipe
- 21 303a piston rod sump outlet port
- 22 304 piston rod

- 1 305 push rod
- 2 306 crank plate
- 3 306a cam drive shaft
- 4 307 output drive shaft cog
- 5 308 multi-function piston
- 6 308a piston oil inlet ports
- 7 308b piston oil outlet ports
- 8 308c oil hoarding rings
- 9 308d piston head
- 10 308e piston base
- 11 309 air/fuel transfer passage
- 12 311 exhaust valve
- 13 312 exhaust valve stem
- 14 313 exhaust valve stem ball
- 15 314 exhaust valve spring
- 16 315 exhaust valve cam
- 17 316 cylinder combustion chamber
- 18 317 cylinder compression chamber
- 19 317a cylinder compression chamber air or air/fuel inlet port
- 20 317b cylinder compression chamber air or air/fuel inlet port one-way reed valve
- 21 317c cylinder compression chamber air or air/fuel outlet port
- 22 317d cylinder combustion chamber air or air/fuel inlet port

1 318 pressure seal

2

3 FIG 3A

4 319 air/fuel transfer passage circular cover

5 320 cylinder compression chamber air or air/fuel outlet circle of ports

6 321 cylinder combustion chamber air or air/fuel inlet circle of ports

7

8 FIG 3B

9 319 air/fuel transfer passage circular cover

10 320 cylinder compression chamber air or air/fuel outlet circle of ports

11 321 cylinder combustion chamber air or air/fuel inlet circle of ports

12

13 FIG 3C

14 319 air/fuel transfer passage circular cover

15 320 cylinder compression chamber air or air/fuel outlet circle of ports

16 321 cylinder combustion chamber air or air/fuel inlet circle of ports

17

18 FIG 3D

19 319 air/fuel transfer passage circular cover

20

21 FIG. 4

22 101b oil sump/crank case combination end walls/cylinder compression walls

1 112 output drive shaft
2 302 sump oil pick-up pipe
3 302a output drive shaft
4 303 oil return outlet pipe
5 304 piston rod
6 305 push rod
7 306 crank plate
8 306a cam drive shaft
9 307 output drive shaft cog
10 318 pressure seal

11

12 FIG. 5

13 101b oil sump/crank case combination end walls/cylinder compression walls
14 112 output drive shaft
15 301 oil
16 302 sump oil pick-up pipe
17 302a sump oil pick-up nozzle
18 303 oil return outlet pipe
19 303a piston rod sump outlet port
20 304 piston rod
21 305 push rod
22 306 crank plate

1 306a cam drive shaft
2 307 output drive shaft cog
3 308 multi-function piston
4 318 pressure seal

5

6 FIG. 6

7 302 sump oil pick-up pipe
8 303 oil return outlet pipe
9 308a piston oil inlet ports
10 308b piston oil outlet ports
11 308c oil hoarding rings
12 601 piston oil inlet channels
13 602 piston oil outlet channels

14

15 FIG. 7

16 308a piston oil inlet ports
17 601 piston oil inlet port channels

18

19 FIG. 8

20 308b piston oil outlet ports
21 602 piston oil outlet port channels

22

1 **FIG. 9**

2 **103a cylinder side wall**

3 **900 air or air/fuel intake valve head**

4 **901 valve seat**

5 **902 valve stem**

6 **902a valve rod**

7 **902b control peg**

8 **903 valve spring**

9 **903a valve spring collar**

10 **904 valve guide**

11 **905 air or air/fuel valve ports**

12 **907 piston oil supply port**

13 **908 piston oil return port**

14 **911 piston rod**

15 **950 multi-function piston**

16

17 **FIG 10**

18 **900 valve head**

19 **901 valve seat**

20 **902 valve stem**

21 **902a valve rod**

22 **903 valve spring**

- 1 **903a valve spring collar**
- 2 **904 valve guide**
- 3 **905 air or air/fuel valve ports**
- 4 **911 piston rod**
- 5 **1006 piston oil supply port**
- 6 **1008 oil hoarding rings**
- 7 **1009 piston head**
- 8 **1010 piston base**
- 9

10 **FIG. 11**

- 11 **900 valve head**
- 12 **903 valve spring**
- 13 **1107 piston oil return port**
- 14

15 **FIG. 12**

- 16 **901 valve seat**
- 17 **902 valve stem**
- 18 **904 valve guide**
- 19 **905 air or air/fuel valve ports**
- 20 **1006 piston oil supply port**
- 21 **1007 piston oil return port**
- 22 **1206 piston oil supply channel**

1 **1207 piston oil return channel**

2

3 **FIG. 12a**

4 **902 valve stem**

5 **904 valve guide**

6 **911 piston rod**

7 **1201 sump oil pick-up pipe**

8 **1202 oil return outlet pipe**

9 **1203 valve stem oil pinhole**

10 **1206 piston oil supply channel**

11 **1207 piston oil return channel**

12

13 **FIG 13**

14 **1301 reciprocating power shaft**

15 **1302 single, unpaired magneto pick-up**

16
17 Detailed Description of the Preferred Embodiments

18 The key novelties of this invention lie in its means of lubrication combined with its
19 means of aspiration and exhaust. A number of alternative modes are offered and they
20 can be "mixed and matched" as needs dictate. Note that in every mode described, fuel
21 injection may be substituted for carburetion, providing increased performance, but at the
22 expense of increased system complexity and monetary cost.

1 Referring to FIG. 1, the engine in the first preferred mode, a two-stroke cycle
2 dynamic pressure powered lubrication configuration (100), has a combination oil
3 sump/crankcase (101) with a top and top plate (101a) and combination end
4 walls/cylinder compression walls (101b), side-walls (101c) and a bottom (101d). It
5 includes an air/fuel intake manifold (102), a carburetor (102a), a fuel inlet (102b), a
6 throttle cable (102c), a carburetor air intake (102d) and a one-way air intake reed valve
7 (102e).

8 On either end of the combination oil sump/crankcase is a cylinder (103) with a
9 sidewall (103a), cylinder head (104), exhaust assembly block (105) exhaust cam block
10 (106) having an exhaust port to atmosphere (107), an air or air/fuel transfer cover (115)
11 and an exhaust cam passive sprocket (108). On each cylinder head is also mounted an
12 air/fuel transfer passage cover and a spark plug (113) with spark plug wire (114)
13 attached.

14 Extending from the facing side wall of the oil sump/crankcase is an output drive
15 shaft (112), a shaft with exhaust cam power sprockets (109) linked to exhaust cam
16 passive sprockets (108) by two exhaust cam drive belts (110), tensioned by an exhaust
17 cam drive belt tensioning pulley (111).

18 Referring to FIG. 2, viewing the engine of FIG. 1 from the opposite side, now
19 additionally detailed are the exhaust assembly block (105), the exhaust cam block
20 (106), the combination flywheel/starter cog (201), the starter motor, shown engaged for
21 starting (202), the exhaust valve cam (206) and the magneto pick-ups (207) connected
22 to the spark plug wires (114).

1 Referring to FIG. 3, which is a partial cut-away view with multi-function pistons
2 intact, one may observe a number of the features that provide a cleaner, more efficient,
3 more dependable, more powerful and more conveniently operated system than extant in
4 prior technology.

5 Keys to this invention are the features that allow engine oil and fuel to remain
6 separate throughout the combustion process. Prior conventional two-cycle engine
7 designs required lubricating oil to be measured and mixed with their fuel. This caused
8 the engines to "burn dirty," producing prodigious levels of toxic emissions, low
9 efficiency, and poor dependability due to constant plug and system fouling. This
10 invention overcomes such problems by incorporating improved aspiration systems and
11 oil circulation systems that allow lubrication while segregating the lubricant from fuel and
12 combustion.

13 One preferred mode, employing (as all preferred modes do) a dynamic pressure
14 lubrication pump system, is illustrated in FIG. 3. Each cylinder (103) has a side-wall
15 (103a), oil sump/crank case combination end walls/cylinder compression wall (101b)
16 that segregates compression chamber (317) fuel and/or air from oil (301) in the crank
17 case/sump (101). This wall is an important key to keeping oil out of the combustion
18 chamber (316). In conventional technology, this wall is absent, leaving the cylinder
19 open to the crankcase. This wall (101b) and its pressure seal (318) also serve as a
20 guide to the piston rod (304) that keeps the rod traveling in strictly liner motion,
21 reducing cylinder wear.

1 In this configuration, oil (301) is picked up by nozzles (302a) of pick-up pipes
2 (302) extending from the piston rod (304) into the crank case/sump (101). These
3 nozzles are thrust to and fro in a reciprocating manner through the sump oil (301) due to
4 the motion of the piston rod (304) to which they are attached. On each thrust, oil is
5 forced into one or the other nozzle by dynamic pressure. The nozzles may be flared in
6 order to increase the dynamic pressure applied. Oil passes through the nozzle, enters
7 the sump oil pick-up pipe (302), via which it then travels to the multi-function piston
8 (308) where it exits via the piston oil inlet ports (308a) and circulates about the multi-
9 function piston (308) between the oil hoarding rings (308c) that prevent the oil (301)
10 from coming in contact with combustion fuel and air or combustion products above or
11 below the multi-function piston (308). As it circulates, continued static pressure from
12 additional oil feed, plus dynamic pressure caused by reciprocating piston rod motion
13 causes the oil to re-enter the multi-function piston (308) through the piston outlet ports
14 (308b) from whence it travels back down the piston rod (304) via an oil return outlet pipe
15 (303) to drip through the piston rod sump outlet (303a) back into the crank case/sump
16 (101) where it cools. Thus, lubricating oil circulation is completed without the oil ever
17 coming into contact with combustion fuel or air.

18 The oil (301) rests in the sump (101) where its cooling is promoted through
19 stirring by motion of the sump oil pick-up pipe (302) until it again enters the circulation
20 system.

21 This diagram illustrates means by which engine performance is further enhanced
22 through the addition of an exhaust valve (311) in each cylinder head (104). Note that

1 each cylinder (103) has an intake port (317d) that resembles and functions in much the
2 same manner those in present popular two-cycle engines. However, the exhaust valve
3 (311) in the cylinder head (104) replaces the standard prior technology exhaust port on
4 the cylinder side-wall. Action of this valve may be independently adjusted in such a way
5 as to obtain maximum scavenging effect, best combustion and best compression time
6 and pressure, allowing the engine to burn more cleanly and making the engine more
7 readily compatible with a wider range of fuels than in previous conventional technology.

8 Further detailed in FIG. 3, are the oil sump/crank case (101), oil in the sump
9 (301), sump oil pick-up pipes (302), sump oil pick-up nozzles (302a), oil return outlet
10 pipes (303) and piston rod oil return outlet ports (303a).

11 A piston rod (304) is linked by a push rod (305) to a crank plate (306) that turns a
12 cam drive shaft (306a) and meshes with an output shaft cog (307) driving an output
13 drive shaft (112). Oil (301) contained in the oil sump/crank case splashes as the
14 various contained components move, thus ensuring complete lubrication of all parts
15 encased therein.

16 Connected to each end of the piston rod is a multi-function piston (308) having
17 piston oil inlet ports (308a), piston oil outlet ports (308b), oil hoarding rings (308c), a
18 piston head (308d), and a piston base (308e).

19 Each cylinder (103) has a head (104) with an exhaust valve (311), exhaust valve
20 stem (312), exhaust valve stem ball (313), exhaust valve spring (314), and exhaust
21 valve cam (315), exhaust ports to atmosphere (107), and spark plugs (113).

1 Each cylinder has a combustion chamber (316), a compression chamber (317),
2 compression chamber air or air/fuel inlet port (317a), compression chamber air or
3 air/fuel inlet port one way reed valve (317b), compression chamber air or air/fuel outlet
4 port (317c), combustion chamber air or air/fuel inlet port (317d), an air or air/fuel
5 transfer passage (309) leading from the compression chamber to the combustion
6 chamber including an air/fuel transfer passage cover (115). At the base of each
7 cylinder is a pressure seal (318) in the oil sump/crankcase combination end walls and
8 cylinder compression walls (101b), through which the piston rod (304) passes.

9 FIG. 3A illustrates an alternative preferred mode with respect to the air or air/fuel
10 transfer passage ports. Instead of equipping each cylinder with a small, elongated air
11 or air/fuel transfer passage and cover with ports into the cylinder at either end (as
12 described in the previously presented mode) this mode substitutes a donut shaped,
13 circular cover (319) that surrounds the cylinder. Under this cover, the cylinder is circled
14 at either end by a ring of outlet ports (320), and inlet ports (321) to facilitate high
15 volume, evenly distributed air flow.

16 FIG. 3B is an enlarged image of a portion of FIG. 3A showing the donut shaped,
17 circular cover (319) that surrounds the cylinder, and the cylinder circled at either end by
18 a ring of outlet ports (320) and inlet ports (321).

19 FIG. 3C further illustrates the features exhibited in FIG. 3B, pointing out the donut
20 shaped, circular cover (319) that surrounds the cylinder and the cylinder circled at either
21 end by a ring of outlet ports (320), and inlet ports (321).

1 FIG. 3D shows the entire exterior arrangement of the engine employing the donut
2 shaped, circular cover (319) that surrounds the cylinder.

3 Now referring to FIG. 4, further detailed for an engine configured in the first or
4 second preferred modes are the combination end walls/cylinder compression walls
5 (101b), the sump oil pick up pipe (302), the sump oil pick-up pipe nozzle (302a), oil
6 return pipe (303), piston rod (304), push rod (305), crank plate (306), cam drive shaft
7 (306a), output drive shaft cog (307), output drive shaft (112) and pressure seal (318).

8 Turning to FIG. 5, expanding on the view in FIG. 4, we can see the combination
9 end walls/cylinder compression walls (101b), the oil (301), the sump oil pick up pipe
10 (302), the sump oil pick-up pipe nozzle (302a), oil return pipe (303), piston rod sump oil
11 outlet port (303a), piston rod (304), push rod (305), crank plate (306), cam drive shaft
12 (306a), output shaft cog (307), output drive shaft (112), the multi-function piston (308)
13 and pressure seals (318).

14 FIG. 6 presents closer detail of the multi-function piston as configured for the first
15 preferred lubrication mode, showing the sump oil pick-up pipe (302), the oil return outlet
16 pipe (303), the piston oil inlet ports (308a), the piston oil outlet ports (308b), the oil
17 hoarding rings (308c), the piston oil inlet channels (601), and the piston oil outlet
18 channels (602).

19 FIG. 7, a cut-away view, further details the multi-function piston shown in FIG. 6
20 showing the piston oil inlet ports (308a) and the piston oil inlet channels (601).

21 FIG. 8, a cut-away view, further details the multi-function piston of FIG. 6,
22 showing piston oil outlet ports (308b) and the piston oil outlet channels (602).

1 Referring to FIG. 9, the key part to the third preferred mode is displayed.
2 This is the "pop top piston" system and this mode provides the most effective
3 means of keeping fuel and lubricant separated in that it allows no overlap
4 whatsoever in the lubrication and aspiration systems. FIG. 9 illustrates the entire
5 system for one cylinder, clearly showing the relationships of the "pop-top" piston
6 system components, to include the control peg (902b).

7 This system includes a piston (950), air or air/fuel ports (906), a piston rod
8 (911), piston oil supply port (907), piston oil return port (908), air or air fuel intake
9 valve head (900), valve seat (901), valve stem (902), valve spring (903), valve
10 spring collar (903a), valve guide (904). The system also includes a valve rod
11 (902a) and a control peg (902b).

12 Detailed is a multi-function piston configured for the third preferred mode.
13 In this mode, an air or air/fuel mixture intake valve head (900) and intake ports
14 (905) are actually located each the piston head. By substituting these valves and
15 ports fixed intake ports in the cylinder side-wall (103a), increased control over
16 air/fuel aspiration becomes possible. In this figure, the piston intake valve head
17 (900) is open. Note that the valve stem (902) extends into the piston head and the
18 valve head (900) fits snuggly in the seats in the piston head valve seat (901).

19 The intake valve head (900) is pushed open by a valve rod (902a) one end
20 of which is attached to a stem (902) of the given valve (900) and the other end
21 of which impinges upon a control peg (902b) that prevents the valve rod (902a)
22 from traveling with the piston rod (911) for its full stroke. When the piston (950)

1 and piston rod (911) begin their power stroke, the valve rod (902a) travels with
2 them, pushed along by the valve stem (902), the inertia of the valve rod (902a)
3 being overcome by the valve spring (903).

4 Before the piston rod (911) completes its power stroke, valve rod (902a)
5 comes in contact with a control peg (902b). This control peg stops further travel
6 of the valve rod (902a). Although the valve rod stops moving, the piston rod (911)
7 continues traveling to the bottom of its power stroke, sliding past the now
8 motionless valve rod (902a). As a result, one end of the now motionless valve rod
9 pushes against the valve stem (902), compressing the valve spring (903) and
10 forcing the valve head (900) open. Air or air/fuel mixture rushes through the
11 opened valve, transiting through air or air/fuel ports (906) in the piston. Shortly
12 thereafter, the piston rod (912) "bottoms out" finishing its power stroke, and
13 reverses direction to start its compression stroke.

14 As the piston rod (911) begins its compression stroke, its motion slides the
15 valve rod (902a) away from the control peg (902b) and allows the valve spring
16 (903) to once again force the valve head (900) closed. As the piston (950)
17 continues in its compression stroke, pressure above it in the combustion
18 chamber furthers serves to keep the valve head (900) firmly seated and closed.
19 The piston stroke continues through compression, combustion and exhaust and
20 the cycle repeats.

21 Lubrication for each piston is accomplished through the dynamic pressure
22 lubrication oil system previously described, with oil distribution accomplished via

1 a piston oil supply port (907) and a piston oil return port (908). (Details of the
2 lubrication system are not illustrated in order to preserve simplicity, but are
3 essentially identical to the dynamic pressure system previously described.)

4 This mode provides increased control over the combustion process in that
5 it allows independent control of the cylinder head exhaust valve and off the air or
6 air/fuel intake valve. This control translates into cleaner, more efficient
7 combustion and increased adaptability to a wide range of fuels. Although this
8 mode offers significant performance benefits, it is also more complex to
9 manufacture and maintain than the first and second preferred modes.

10 FIG 10 provides increased detail as to how the various parts of the "pop-
11 top" piston relate and function. In this drawing the valve rod (902a), co-axial to
12 the piston rod (911), is pressing against valve stem (902), compressing the valve
13 spring (903) via the valve spring collar (903a) and forcing the valve head (900)
14 open. The valve stem is held in place by a valve guide (904). The piston is
15 lubricated by oil emitting from the piston oil supply port (1006).

16 The piston is centered in its cylinder by the oil hoarding rings (1008) that
17 also keep the lubrication oil from escaping above or below the piston. When the
18 valve head (900) opens, air or fuel/air mixture rushes up from the base of the
19 piston (1010) through the air or air/fuel valve ports (905) past the valve seat (901)
20 and out through the piston head (1009).

21 FIG. 11 displays the "pop-top" piston system viewing the opposite side
22 from FIG. 10 so that the piston oil return port (1107) is visible. Oil is forced

1 through this port by static pressure of additional oil pumped to the piston. The
2 oil enters this port and returns to the engine sump/crankcase. In this illustration,
3 the valve head (900) is closed, showing the valve spring (903) uncompressed in
4 its resting position.

5 FIG. 12 provides an end view of the piston air or air/fuel ports (905), and of
6 the piston oil supply channels (1206) and return channels (1207), that feed oil to
7 and from the piston oil supply ports (1006) and piston oil return ports (1007), also
8 feeding oil in minute quantities to lubricate the valve stem in the center of the
9 piston. The relationships of the valve seat (901), valve stem (902), and valve
10 guide (904) and the air or air/fuel valve ports (905) to the rest of the piston are
11 defined.

12 In FIG. 12a, viewing the center section of FIG. 12 in further detail, note that
13 opposite the bases of the piston oil supply (1206) and piston oil return (1207)
14 channels, and extending from the sump oil pick-up pipe (1201) and from the sump
15 oil return outlet pipe (1202), there are valve stem pinholes (1203) leading through
16 the valve guide (904) to the valve stem (902), centered in the piston rod (911), via
17 which minute quantities of oil may pass in order to lubricate the valve stem (902)

18 FIG. 13 shows the engine configured to operate with only one cylinder and
19 piston. Particularly singled out are the reciprocating power shaft (1301) that moves only
20 in a liner "in and out" manner and the single, unpaired magneto pick-up (1302).

1 In addition to the features documented in these drawings, further benefits may be
2 derived by incorporating different means of ignition, to include not only spark plugs, but,
3 alternatively, glow plugs and/or explosive compression in the combustion chamber.

4 Additionally, alternate incorporation of various drive trains, substituting, for
5 example, a rack and pinion, ratchet drive, or uni-directional or segmented gear
6 arrangement in place of the crank plate system here described, may render the system
7 lighter and more compact and may allow greater flexibility in choice of fuels by providing
8 for a greater range of piston dwell times than in rotary transmission systems, thus
9 promoting more complete and efficient fuel combustion. The engine may also
10 significantly benefit from addition of an oil cooler and from a turbo-charger, super-
11 charger, intake air compressor, fan, or blower. While the invention has been described
12 in connection with preferred embodiments, it is not intended to limit the scope of the
13 invention to the particular forms set forth, but on the contrary, it is intended to cover
14 such alternatives, modifications, and equivalents as may be included within the spirit
15 and scope of the invention as defined by the appended claims.

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1 Appendix 2 to Amendment C
2 Claims with Replacement Portions Marked-Up to Indicate Changes
3
4
5

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Pursuant to Rule 121, the following is a copy of all of the Pending Claims as amended by the attached Amendment C, with all changes indicated by striking through deletions and underlining additions:

1 Claims

2 What is claimed is:

3 27.(previously amended) An internal combustion engine machine incorporating
4 significant improvements in power, efficiency and emissions control comprising:

5

6 (a) one or more cylinders, each comprising at least one head, combustion
7 chamber, base, compression chamber and sidewall;

8

9 (b) one or more means of igniting fuel in the cylinder(s);

10

11 (c) one or more sources of intake air;

12

13 (d) at least one means of storing and/or cooling lubricating oil between
14 cycles of circulation;

15

16 (e) a drive train;

17

18 (f) at least one means of encasing, protecting, cooling and lubricating the
19 drive train;

20

21 (g) at least one means of segregating the oil in the sump and/or crankcase
22 from the air or air/fuel mixture in the cylinder, whether within or apart from the
23 combustion chamber.

24

(i) at least one means of transmitting energy to and from the pistons;

6 (j) at least one means of guiding each piston rod such that it moves in a
7 linear manner, always along substantially the same line;

13 (I) at least one means of admitting air and fuel, or air/fuel mixture into each
14 cylinder apart from the combustion chamber:

16 (m) at least one means of efficiently expelling exhaust gases resulting
17 from combustion of the air fuel mixture after energy has been extracted:

19 (n) at least one means of transmitting energy from the piston rod to the
20 drive train:

(o) at least one means of cooling the engine; and

4 (q) wherein the means of efficiently expelling exhaust gases upon
5 completion of combustion and energy extraction comprises a cylinder head exhaust
6 valve, allowing exhaust to exit through the head of the cylinder.

8 28.(previously amended) An internal combustion engine machine incorporating
9 significant improvements in power, efficiency and emissions control comprising:

11 (a) one or more cylinders, each comprising a head, a combustion
12 chamber, a base, a compression chamber and a sidewall:

(b) one or more means of igniting fuel in the cylinder(s);

16 (c) one or more sources of intake air;

18 (d) at least one means of storing and/or cooling lubricating oil between
19 cycles of circulation;

21 (e) a drive train;

23 (f) at least one means of encasing, protecting, cooling and lubricating the
24 drive train;

1 (g) at least one means of segregating the oil in the sump and/or crankcase
2 from the air or air/fuel mixture in the cylinder, whether within or apart from the
3 combustion chamber.

4

5 (h) at least one means of dispersing oil on the cylinder walls and of then
6 gathering excess for return to the oil sump;

7

8 (i) at least one means of transmitting energy to and from the pistons;

9

10 (j) at least one means of guiding each piston rod such that it moves in a
11 linear manner, always along substantially the same line;

12

13 (k) at least one means of drawing air or air/fuel mixture into the engine
14 machine, propelling it into the cylinder combustion chamber, compressing it for ignition
15 and propelling its expulsion after ignition;

16

17 (l) at least one means of admitting air and fuel, or air/fuel mixture into each
18 cylinder apart from the combustion chamber;

19

20 (m) at least one means of efficiently expelling exhaust gases resulting
21 from combustion of the air fuel mixture after energy has been extracted;

22

23 (n) at least one means of transmitting energy from the piston rod to the
24 drive train;

(o) at least one means of cooling the engine;

(p) at least one means of transporting, dispersing, gathering, and returning

lubricating/cooling oil while keeping it segregated from combustion air and fuel; and

(q) at least one means of collecting, storing, and transferring inertial energy from

one drive stroke to another, comprising at least one inertial mass or flywheel.

10 29.(previously amended) An internal combustion engine machine incorporating
11 significant improvements in power, efficiency and emissions control comprising:

(a) one or more cylinders, each comprising at least one head, combustion space, compression chamber and sidewall;

(b) one or more means of igniting fuel in the cylinder(s);

(c) one or more sources of intake air;

(d) at least one means of transporting dispersing gathering and returning
and ,or, or, cooling oil;

23 (e) at least one means of storing and/or cooling lubricating oil between
24 cycles of circulation;

1 (f) at least one means of dispersing lubricating oil on the cylinder walls and
2 of then gathering excess for return to an oil sump;

3

4 (g) at least one means of segregating lubricating oil from the combustion
5 air or air/fuel mixture, and combustion products at substantially all points in the engine.

6

7 (h) at least one drive train;

8

9 (i) at least one means of, protecting, cooling and, or, or, lubricating the
10 drive train;

11 (j) at least one means of transmitting energy to and from the pistons;

12

13 (k) at least one means of guiding each piston rod such that it moves in a
14 linear manner, always along substantially the same line;

15

16 (l) at least one means of drawing air or air/fuel mixture into the engine
17 machine, of propelling it into the cylinder combustion chamber, of compressing it for
18 ignition, and of propelling its expulsion after ignition;

19

20 (m) at least one means of admitting air, fuel, or an air/fuel mixture into
21 each cylinder; apart from the combustion chamber.

22

23 (n) at least one means of expelling exhaust gases resulting from
24 combustion of the air fuel mixture after energy has been extracted;

(p) at least one means of cooling the engine; and

6 (q) at least one means of expelling exhaust gases upon completion of
7 combustion and energy extraction comprising at least one cylinder head exhaust valve,
8 allowing exhaust to exit through the head of the cylinder.

10. 30. (previously amended) An internal combustion engine machine as in claim 27
11 comprising at least one plurality of cylinders in one or more banks of two opposing
12 cylinders each.

14 31. (previously amended) An internal combustion engine machine as in claim 27
15 wherein the means of transmitting energy to and from the each piston comprises;

17 (a) at least one piston-rod with a piston attached at one end;

19 (b) each piston rod passing through the base of its cylinder, carrying the
20 force of its associated piston power stroke to the drive train;

(c) the piston rod linked to the drive shaft by at least one push rod in the crankcase/oil sump, propelling at least one transmission mechanism, comprising at least one crank-plate, or other rotary, or liner device powering at least one drive shaft.

1 32. (previously amended) An internal combustions engine machine as in claim 27
2 wherein the means of cooling the engine comprises exhaust gas expansion, cooling fins
3 and at least one volume of oil circulated through the cylinders and pooled in the sump,
4 the sump acting as at least one heat sink for oil circulating from the cylinders.
5

6 33. (previously amended) An internal combustion engine machine as in claim 27
7 wherein the means of transmitting energy from the piston rod to the drive train
8 comprises at least one rotary device, linked to the piston rod by at least one push rod.
9

10 34. (previously amended) An internal combustion engine machine in claim 27 in which
11 the means of transmitting energy from the piston rod to the drive train comprises at least
12 one rack and pinion transmission system, segmented gear drive, or ratchet device.
13

14 35. (previously amended) An internal combustion engine machine as in claim 27
15 wherein the means of admitting the fuel component of the air/fuel mixture into each
16 cylinder comprises at least one fuel injector for each cylinder.
17

18 36. (previously amended) An internal combustion engine machine as in claim 27
19 wherein the means of admitting air or air/fuel mixture into each cylinder obtained by
20 intake ports in the sidewall of each cylinder.
21

22 37. (previously amended) An internal combustion engine machine as in claim 27
23 wherein the means of efficiently expelling exhaust gases upon completion of

1 combustion and energy extraction comprises at least one cylinder head exhaust valve,
2 allowing exhaust to exit through the head of the cylinder.

3

4 38. (previously amended) An internal combustion engine machine as in claim 27
5 wherein a means of drawing air or air/fuel mixture into the system, propelling it into the
6 cylinder combustion chamber, compressing it for ignition and expelling it after ignition
7 comprises at least one multi-function piston, that:

8

9 (a) on upstroke, draws air from an intake source and into an
10 intake/compression chamber beneath the piston, at the same time, compressing an
11 air/fuel mixture in the cylinder combustion chamber above the piston, and then,

12

13 (b) on down stroke, following combustion of the air/fuel mixture,
14 compresses and propels scavenge air out of the intake/compression chamber below the
15 piston, and into the cylinder combustion chamber above the piston, then,

16

17 (c) on the following up-stroke, expels the scavenge air and remaining
18 exhaust from the combustion chamber, at the same time drawing combustion air or a
19 combustion air/fuel mixture into an intake/compression chamber below the piston, then,

20

21 (d) on the following down stroke; compresses and propels the combustion
22 air or air/fuel mixture, out of the intake/compression chamber below the piston, and into
23 the cylinder combustion chamber above the piston, for combustion, completing a cycle.

24

1 39. (previously amended) An internal combustion engine machine as in claim 27
2 wherein a means of drawing air or air/fuel mixture into the system, propelling it into the
3 cylinder combustion chamber, compressing it for ignition and expelling it after ignition
4 comprises a two stroke process wherein at least one multi-function piston:

5

6 (a) on a single up stroke, draws combustion air or air/fuel mixture from the
7 intake source and into an intake/compression chamber beneath the piston, and
8 compresses the air or air/fuel mixture in the combustion chamber, then,

9

10 (b) upon combustion, on a single down stroke, propels combustion air or
11 air fuel mixture out of the compression chamber into a cylinder combustion chamber
12 above the piston, at the same time expelling the exhaust from the combustion chamber
13 and completing the combustion/exhaust cycle.

14

15 40. (previously amended) An internal combustion engine machine as in claim 27
16 wherein the means of guiding each piston rod such that it moves in a linear manner,
17 always along substantially the same line, comprises at least one compression wall and
18 at least one piston rod compression seal, the compression seal serving as a piston rod
19 guide to hold each piston in correct position within its cylinder.

20

21 41. (previously amended) An internal combustion engine machine as in claim 27
22 wherein there is provided for each cylinder, at least one multi-function piston performing
23 in four strokes, intake, compression, combustion, exhaust and power functions plus
24 lubrication, these comprising, to:

1 (a) draw in new combustion air or air/fuel mixture into an
2 intake/compression chamber, separate from the cylinder combustion chamber,
3
4 (b) compress and propel the new air or air/fuel mixture from the
5 intake/compression chamber, into the cylinder combustion chamber,
6
7 (c) compress the air/fuel mixture in the cylinder combustion chamber,
8
9 (d) draw in scavenge air into an intake/compression chamber, separate
10 from the cylinder combustion chamber,
11 (e) receive the force of combustion for transmission to the piston rod,
12
13 (f) compress and propel the scavenge air from the intake/compression
14 chamber, into the cylinder combustion chamber,
15
16 (g) compress and propel the scavenge air and combustion by-products
17 from the cylinder combustion chamber as exhaust, and
18
19 (h) receive, disperse and recoup lubricating oil for return to the oil
20 sump/coolier.
21
22 42. (previously amended) An internal combustion engine machine as in claim 27
23 wherein there is provided for each cylinder, at least one multi-function piston

1 performing, in two strokes, intake, compression, combustion, exhaust and power
2 functions plus lubrication, these comprising, to:

3

4 (a) in a single upstroke, draw new combustion air or air/fuel mixture into
5 an intake/compression chamber, separate from a cylinder combustion chamber, and in
6 the same action, compress an air/fuel mixture in the cylinder combustion chamber,

7

8 (b) receive the force of combustion for transmission to the piston rod,

9

10 (c) in a single down-stroke, upon combustion in the cylinder combustion
11 chamber, compress and propel the new air or air/fuel mixture from the
12 intake/compression chamber, into the cylinder combustion chamber, and in the same
13 action, scavenge and exhaust combustion by-products from the cylinder combustion
14 chamber, and,

15

16 (d) receive, disperse and recoup lubricating oil for return to the oil
17 sump/cooler.

18

19 43. (previously amended) An internal combustion engine machine as in claim 27
20 wherein the means of dispersing oil on the cylinder walls and of then gathering excess
21 for return to the oil sump comprises oil hoarding rings, at least one ring located near the
22 head and base of at least one piston, such that the rings contain any oil dispersed
23 between them, and when in motion, push said oil before them, substantially wiping it off
24 the cylinder walls as they move.

1 **44. (previously amended) An internal combustion engine machine as in claim 27**
2 wherein a means of segregating the oil in the sump and/or crank case from the air or
3 air/fuel mixture in the cylinder comprises at least one compression wall and piston rod
4 pressure seal at the base of at least one cylinder;

5

6 (a) the compression wall segregating the fuel, air, or combustion by-
7 products in at least one cylinder from the lubricating, and, or, or, oil in the oil
8 sump/crankcase, thus creating at least one segregated and sealed intake chamber into
9 which the air or fuel/air mixture is first received from the carburetor, breather, or other
10 combustion air source, and from which it is discharged into the cylinder combustion
11 chamber; and

12

13 (b) a piston rod passing through the compression wall at the base of each
14 corresponding cylinder and into the sump/crankcase by way of the compression wall
15 and pressure seal.

16

17 **45. (previously amended) An internal combustion engine machine as in claim 27**
18 wherein a means of encasing, protecting, and lubricating the drive train comprises at
19 least one combination crankcase, and, or, or, oil sump;

20

21 **46. (previously amended) An internal combustion engine machine as in claim 27**
22 wherein a means of storing and/or cooling the oil between cycles of circulation
23 comprises at least one combination crankcase/oil sump;

24

1 47. (previously amended) An internal combustion engine machine as in claim 27
2 wherein a source of intake air comprises at least one carburetor;
3
4 48. (previously amended) An internal combustion engine machine as in claim 27
5 wherein a means of igniting the fuel comprises an electrical spark;
6
7 49. (previously amended) An internal combustion engine machine as in claim 27,
8 wherein a means of transporting, dispersing, gathering and returning lubricating, and,
9 or, or, cooling oil while keeping it segregated from combustion air and fuel comprises;
10
11 (a) at least one dynamic force lubricating oil pump comprising at least one
12 piston rod/lubrication assembly that serves as both at least one means of transmitting
13 force to and from the piston and as at least one means to transmit lubricating/cooling oil
14 to an associated cylinder via at least one multi-function piston assembly;
15
16 (b) at least one multi-function-piston assembly comprising at least one
17 piston rod with at least one multi-function piston attached to either or each end, and
18 having one or more oil pick-up and exhaust ports in its mid section, and one or more oil
19 transport passages in the piston rod from the oil pick-up nozzles to the multi-function-
20 piston and back to the oil exhaust ports;
21
22 (c) each multi-function-piston comprising one or more radially
23 situated oil inlet and outlet ports that distribute lubricating oil to the associated

1 cylinder and recover the oil for return to the sump/crankcase, and each multi-
2 function piston also comprising;

3

4 (d) at least one oil hoarding ring near each piston head and base to
5 assist in dispersing and then re-gathering the oil for return to a sump such that oil
6 flows through the piston rod and piston, and around the piston, lubricating and
7 cooling piston walls, piston rings and cylinder walls, and returns through the
8 piston and piston rod to the oil sump.

9

10 50. (previously amended) An internal combustion engine machine as in claim 27
11 wherein at least one wrist pin links each piston to its piston rod.

12

13 51. (previously amended) An internal combustion engine machine as in claim 27
14 wherein a means of igniting fuel in the cylinders comprises explosive compression in the
15 cylinder head.

16

17 52. (previously amended) An internal combustion engine machine as in claim 27
18 wherein a means of igniting fuel in the cylinders comprises at least one glow plug.

19

20 53. (previously amended) An internal combustion engine machine as in claim 27
21 wherein a means of igniting fuel in the cylinders comprises at least one electrical spark.

22

23 54. (previously amended) An internal combustion engine machine as in claim 28
24 wherein a means of transmitting energy to and from the pistons comprises at least one

1 piston-rod between and joining each pair of pistons in each cylinder bank such that
2 each piston rod has a piston at each end,

3

4 (a) each piston rod passing through the base of its associated cylinder,
5 each piston rod carrying the force of its associated piston power stroke to the drive train,
6 and across to the opposite associated piston, thereby, powering that piston's
7 compression stroke, and

8

9 (b) at least one piston rod linked, directly or indirectly, to a drive shaft, via
10 at least one rotary or liner energy transmission device.

11

12 55. (previously amended) An internal combustion engine machine as in claim 28
13 comprising at least one plurality of banks of cylinders, each bank comprised of two or
14 more cylinders and the drive train of each bank joined to the drive train of its
15 neighboring bank(s) in such a way that each bank may be independently disconnected
16 from its neighbor(s) and shut down automatically or at the discretion of the operator, the
17 manner of joining the bank drive trains being, in example, manual clutch(es), centrifugal
18 clutch(es), or ratchet devices.

19

20 56. (previously amended) An internal combustion engine machine incorporating
21 significant improvements in power, efficiency and emissions control comprising;

22

23 (a) one or more cylinders, each comprising at least one head, combustion
24 chamber, base, compression chamber and sidewall;

- (b) one or more means of igniting fuel in the cylinder(s);
- (c) one or more sources of intake air;
- (d) at least one means of storing and/or cooling lubricating oil between circulation;
- (e) a drive train;
- (f) at least one means of encasing, protecting, cooling and lubricating the
- (g) at least one means of segregating the oil in the sump and/or crankcase or air/fuel mixture in the cylinder;
- (h) at least one means of dispersing oil on the cylinder walls and of then access for return to the oil sump;
- (i) at least one means of transmitting energy to and from the pistons;
- (j) at least one means of guiding each piston rod such that it moves in a straight, always along substantially the same line;

(k) at least one means of drawing air or air/fuel mixture into the engine and expelling it into the cylinder combustion chamber, compressing it for ignition and its expulsion after ignition;

(I) at least one means of admitting air and fuel, or air/fuel mixture into each

(m) at least one means of efficiently expelling exhaust gases resulting from the air fuel mixture after energy has been extracted;

(n) at least one means of transmitting energy from the piston rod to the

(o) at least one means of cooling the engine; and

(p) at least one means of transporting, dispersing, gathering, and returning
soling oil while keeping it segregated from combustion air and fuel;

(q) wherein, the means of transporting, dispersing, gathering and returning oiling oil while keeping it segregated from combustion air and fuel least one dynamic force lubricating oil pump comprising:

(r) at least one piston rod/lubrication assembly that serves both as means of transmitting force to and from the piston and as at least

1 one means to transmit lubricating/cooling oil to and from its cylinder in concert
2 with at least one multi-function piston;

3

4 (s) the piston rod/lubrication assembly comprising at least one
5 piston rod with a multi-function piston attached to each end, oil pick-up nozzles
6 and exhaust ports in its mid section, and oil transport passages in the piston rod
7 from the oil pick-up nozzles to the multi-function piston and back to the oil
8 exhaust ports;

9

10 (t) the multi-function piston comprising at least one piston
11 configured with one or more radially situated oil inlet and outlet ports that
12 distribute lubricating oil received from the piston rod/lubrication assembly,
13 to the associated cylinder, and that recover the oil for return to the
14 sump/crankcase via the piston rod/lubrication assembly; and

15

16 (u) the multi-function-piston assembly also comprising oil hoarding rings
17 near each piston head and base to assist in dispersing and then re-gathering the oil for
18 return to the cooling, sump such that oil flows through the piston rod and piston, and
19 around the piston, and returns through the piston and piston rod to the oil sump/crank
20 case.

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22 **57.(newly re-inserted equivalent of old claim 7) An engine machine as in claim 27**
23 **wherein the means of admitting air or air/fuel mixture into each cylinder is a "pop-**

1 **top" piston comprising a valve in the piston head that periodically opens to admit**
2 **new air or fuel/air mixture for each combustion.**

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4 **58. (newly re-inserted old claim 8) An engine machine as in claim 27 wherein the**
5 **means of admitting the fuel component of the air/fuel mixture into each cylinder**
6 **is via a fuel injector for each cylinder.**

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1 Abstract of the Disclosure

2 A two stroke cycle internal combustion engine machine that does not require
3 lubricating oil to be mixed with its fuel, producing greater efficiency, higher power to
4 weight ratio, cooler operating temperatures, a wider speed range, greater simplicity, and
5 lower toxic emissions, many of the improvements also transferable to four stroke
6 engines.

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